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[NAME OF DOCUMENT] SPECIFICATION 1

[NAME OF DOCUMENT] DRAWINGS 1

[NAME OF DOCUMENT] ABSTRACT 1

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[Title of the invention]

INK-JET HEAD

[Claims]

[Claim 1]

An ink-jet head comprising:

a head unit including a plurality of ink ejecting nozzles, a plurality of pressure chambers communicating with the respective nozzles, a common ink chamber communicating with the pressure chambers, and an actuator unit for imparting squirting energy to the ink in the pressure chambers, the head unit being formed by laminating a plurality of sheet members; and

a print board connected to the actuator unit,

wherein a dam portion is formed on one of the sheet members which is placed on an opening for drawing out the print board, the dam portion protruding to a direction of laminating the sheet members.

[Claim 2]

The ink-jet head according to claim 1, wherein:

the pressure chambers are arranged in matrix;

the actuator unit has a piezoelectric sheet placed on the pressure chambers and a plurality of driving electrodes disposed on the piezoelectric sheet so as to opposite to the respective pressure chambers; and

the print board has a plurality of contact points corresponding to the locations of the driving electrodes.

[Claim 3]

The ink-jet head according to claim 1 or 2, wherein the dam portion is formed by an etching, and protrudes from a protruding location from an end surface of the head unit toward the lamination direction.

[Claim 4]

The ink-jet head according to any one of claims 1 to 3, wherein the dam portion is formed by a half-etching.

[Detailed Description of the Invention]

[0001]

[Field of the Invention]

The present invention relates to an ink-jet head for squirting ink at recording medium for recording a formed image.

[0002]

[Prior Art]

In the prior art, there is an ink-jet head described in Patent document 1. In the ink-jet head, a sealing member is disposed on an opening where a FPC board (print board) and individual electrodes (driving electrodes) are connected with each other. The ink-jet head is configured to laminate an oscillation basal member that is disposed on a floor of a liquid chamber communicating with a common ink chamber and an electrode plate formed with a depressed portion and having the individual

electrodes on a floor of the depressed portion. A predetermined gap (spaced portion) is formed between an oscillation plate of the oscillation basal member which is to be a common electrode, a first electrode, and constitutes the floor of the oscillation basal member, and the individual electrodes. Meanwhile, a FPC board consisting of a FPC imparting a driving wave to the individual electrodes and the individual electrodes are bonded by a thermal compression, etc., on a location near the opening where a gap that is formed on a vertical lower part of the oscillation plate and the outside of the head communicate with each other.

[0003]

Meanwhile, in the case where the ink fed from the opening is adhered to a pin hole existing on an individual electrode (typically, an insulation film is formed on an individual electrode, however, the insulation film can not be completely formed and thus minute pin holes may exist), an actuator constituted by the individual electrodes and the oscillation plate is not properly deformed and thus it causes to reduce characteristics of the individual electrodes. Accordingly, sealing members are disposed on the opening for the ink not to be entered.

[0004]

[Patent document 1]

Japanese Published Unexamined Patent application

[0005]

[Problems that the Invention is to solve]

However, in the aforementioned ink-jet head, even though ink is prevented from entering into the parts constituting an actuator by the sealing member (sealing material), in stacking the sealing members, the sealing member itself enters into the gap and adheres to the actuator and thus it causes to reduce a deformation of the actuator, thereby making ink not discharged properly.

[0006]

The object of the present invention, taking the aforementioned problems into consideration, is to provide an ink-jet head in which a sealing member is prevented from entering into a space where an actuator unit is disposed.

[0007]

[Means for Solving the Problems]

An ink-jet head described in claim 1 comprises: a head unit including a plurality of ink ejecting nozzles, a plurality of pressure chambers communicating with the respective nozzles, a common ink chamber communicating with the pressure chambers, and an actuator unit for imparting squirting energy to the ink in the pressure chambers, the head unit being formed by laminating a plurality of sheet members; and a print board connected to the actuator unit, wherein a dam portion is formed

on one of the sheet members which is placed on an opening for drawing out the print board, the dam portion protruding to a direction of laminating the sheet members.

[0008]

According to this configuration, a dam portion is formed on a sheet member included in a head unit and thus a sealing member can be prevented from entering into the space where an actuator is disposed by a simple structure, without increasing the numbers of components. Accordingly, it can be avoided that the sealing member adheres to the actuator unit and thus it hinders an operation of the actuator.

[0009]

The ink-jet head described in claim 2, according to claim 1, is characterized in that: the pressure chambers are arranged in matrix; the actuator unit has a piezoelectric sheet placed on the pressure chambers and a plurality of driving electrodes disposed on the piezoelectric sheet so as to opposite to the respective pressure chambers; and the print board has a plurality of contact points corresponding to the locations of the driving electrodes.

[0010]

According to this configuration, in the case where the pressure chambers are arranged in matrix, the driving electrodes are disposed corresponding to the pressure chambers and the print board is installed corresponding to the locations of

electrodes, the print board is typically disposed on the upper part of the head unit and enters into the inside of the head unit, and thus the sealing member can enter easily into the inside of the head unit. Even in this case, according to the present configuration, the sealing member can be prevented from entering into and adhering to the actuator unit by the dam portion, thereby avoiding operational obstacle of the actuator unit.

[0011]

The ink-jet head described in claim 3, according to claim 1 or 2, is characterized in that the dam portion is formed by an etching and protrudes from a protruding location from an end surface of the head unit toward the lamination direction.

[0012]

According to this configuration, the dam portion is formed by once etching, and therefore, a manufacturing cost can be reduced.

[0013]

An ink-jet head described in claim 4, according to any one of claims 1 to 3, is characterized in that the dam portion is formed by a half-etching.

[0014]

According to this configuration, half-etching one sheet member forms the dam portion. Therefore, a manufacturing cost can be reduced. In addition, the numbers of process can be reduced.

[0015]

[Embodiment of the Invention]

Hereinafter, a description of the embodiment of the present invention will be made based on the drawings.

[0016]

FIG. 1 is a side view of an entire construction of an ink-jet head (printer) according to an embodiment of the present invention. FIG. 2 is a bottom view showing a state in which ink-jet heads are arranged adjacent each other. FIG. 3 is a partly cross-sectional view of the side of the ink-jet head. FIG. 4 is a schematically perspective view of a branched passage-unit of the ink-jet head body. FIG. 5 is a sectional enlarged view showing an ink passage within the passage unit. FIG. 6 is a partly cross-sectional view showing a side of a variant embodiment of a reservoir unit of the ink-jet head; corresponding to a pressure chamber of the head body shown in FIG. 7 is an enlarged plan view of main parts showing a state in which an actuator unit is installed to the passage unit. FIG. 8 is an enlarged cross-sectional view of the areas viewed form a side direction, and surrounded by the part shown with broken-lines in FIG. 9 is a schematically view showing a shape of a driving electrode.

[0017]

<Whole construction of a printer>

A color ink-jet printer (1; ink-jet recording device)

as shown in FIG. 1 is provided with a paper feed portion 11 on the left side of the drawing and a paper discharge portion 12 on the right side of the drawing, and a paper carrier passage running from the paper feed portion 11 toward the paper discharge portion 12 is formed on an interior thereof. Meanwhile, four ink-jet heads 2 are provided on the intermediate portion of the paper carrier passage. A detailed construction of the ink-jet head 2 will be described later.

[0018]

A pair of paper feed rollers 5, 5 are disposed on the directly downstream side of the paper feed portion 11, to feed the paper of the image recording medium from the left to right when viewed in the drawing. Two belt rollers 6, 7 and a loop carrier belt 8 wound to be extended between the both rollers 6, 7 are disposed in an intermediate portion of the paper carrier passage. The outer peripheral surface is treated with a silicon such that the paper carried by the pair of paper feed rollers 5, 5 is held on the carrying surface on the front side of the carrier belt 8 through absorption, while it is carried downstream of the carrying direction (toward the right side as viewed in the drawing) by the drive for rotation of one of the belt rollers 6. In addition, a reference number 9 refers to a presser member, wherein the presser member 9 serves to press the paper down on the carrying surface of the carrier belt 8 to hold it thereon, so as to ensure the carriage of the paper on the carrying surface.

[0019]

A paper releasing mechanism 10 is arranged on the right side as viewed in the drawing and is structured to release the paper held on the carrying surface of the carrier belt 8 and feed it to a paper discharge portion 12 on the right side.

[0020]

The four ink-jet heads 2 of the printer 1 are arranged adjacent each other along the paper carrier direction, corresponding to four color inks (magenta, yellow, cyan, and black). The ink-jet head 2, as viewed from the lower surface thereof in FIG. 2, is formed in a shape of an extended-rectangular cross-section that a longitudinal dimension orthogonal to the paper carrying direction is extended and on the head unit 18 attached on the bottom surface thereof, a number of ink squirting nozzles 13 having a very small diameter (Hereinafter, named as a nozzle) are formed adjacent each other.

[0021]

The ink-jet head 2 is set in place to define a small space between the lower surface of the ink-jet head and the carrying surface of the carrier belt 8, and the paper carrier passage is formed in that space. Under this construction, paper carried by the carrier belt 8 passes in sequence through the bottom side vertical to the head unit 18 of the four ink-jet heads 2 and squirts its respective color ink from the nozzle 13 toward the upper surface of paper (recording surface) in

such a way as to form a desired color image on the paper.

[0022]

<Construction of an ink-jet head>

FIG. 3 is a partly cross-sectional view of the side of the ink-jet head 2 and the ink-jet head 2 is mounted on an adequate member 14 provided in the printer 1 through a holder 15. The holder 15 is formed in an inverted T-shape having a vertical portion 15a and a horizontal portion 15b, when viewed from side. The vertical portion 15a is mounted on the printer body by a screw 16, while the reservoir unit 40 and passage unit 20 constituting the head unit 18 are fixed in order to the bottom surface of the horizontal portion 15b through a spacer 3.

[0023]

The head unit 18 includes a passage unit20, an actuator unit 19, and a reservoir unit 40, as shown in FIG. 3.

Hereinafter, the passage unit 20, the actuator unit 19 and the reservoir unit 40 will be described schematically.

[0024]

Even though a detailed construction of the passage unit 20 will described later, the passage unit 20 has a laminated structure formed by lamination of a plurality of thin sheet members in shapes of rectangular flat plates (Hereinafter, sheet member refers to flat plate in some case). The inlets 20a, nozzle 13, pressure chambers 34 that are communicated with the respective nozzles 13, and common ink chamber 30 (manifold

channel) that is communicated with the pressure chambers 34, are formed on the passage unit 20.

[0025]

The actuator unit 19 is formed as a flat plate in a shape of a thin sheet, and actuator units are mounted adjacent each other to a surface directed toward the reservoir unit 40 of the passage unit 20. As shown in FIG. 4 with broken lines and additionally shown in FIG. 7, a contour line of the actuator unit 19 is formed as a trapezoid (that is, a shape having one set of longer and shorter sides in parallel). The actuator unit 19 is disposed on the passage unit 20 in such a way as for the one set sides to be directed to in parallel with a direction of elongation of the passage unit 20 and the loner sides of the one set sides of the adjacent actuator units 19 are opposed to each other.

[0026]

Even though a detailed construction of the reservoir unit 40 will be described later, like the passage unit 20, it has a laminated structure formed by sheet members 41, 42 in shapes of rectangular flat plate. The reservoir unit 40 is provided with an ink supply passage 41a connected to (not shown) an ink supply source (ink tank), each ink discharge passage communicating with the inlet 20a of the passage unit 20, and an inner ink branching-passage 42f.

[0027]

Under the aforementioned configuration, the reservoir unit 40 is laminated and adhered to the passage unit 20 by a method of fitting the actuator unit 19 (however, a adhesion is not made between the actuator unit 19 and reservoir unit 40, but a adequate space is defined therebetween). As a result, the head unit 18 is formed in such a way as to laminate sheet members in shapes of rectangular thin plate.

[0028]

<Construction of a reservoir unit>

A detailed construction of the reservoir unit 40 will be described.

The reservoir unit 40 is fabricated by adhering a first plate 41 to a second plate 42 (two plates shown in the upper part in FIG. 4). Two plates 41, 42 are made of metal material (for example, stainless material).

[0029]

The first plate 41 is formed through the ink supply passage in a thickness direction thereof and ink fed from (not shown) the ink supply source is introduced into the inside of the reservoir unit 40 through the ink supply passage 41a. The ink supply passage 41a, as shown in FIG. 4, is formed on a central axis in a direction of the shorter length and on one side of the longer length of the first plate 41. In addition, the ink supply passage 41a is not necessarily limited to one, and thus two or greater ink supply passages may be formed. Furthermore,

the ink supply passage does not need to be formed in a specific shape.

[0030]

The second plate 42 is provided with an ink branching passage 42f formed by half-etching on a surface facing the first plate 41. The ink branching passage 42f has a thick and long main passage 42a formed in parallel with a direction of longer length and short sub-passages 42c branched from the main passage 42a. The sub-passages 42c are formed, respectively, by cutting a side wall of the main passage 42a in a shape of a semi-circle and an ink discharge passage 42b is formed as a through shape on the part corresponding to the end of the sub-passage 42c. The location where the ink discharge passage 42b is formed is overlapped with the inlet 20a of the aforementioned passage unit 20, and in case where the passage unit 20 is adhered to the reservoir unit 40, each ink discharge passage 42b of the reservoir unit 40 is communicated with the corresponding inlet 20a of the passage unit 20.

[0031]

In addition, an edge of the second plate 42 is left on a surface directed to the passage unit 20 of the second plate 42 (42d; opposite to the surface on which the ink branching passage 42f is formed), and the depressed portion is formed by a half-etching. The depressed portion 42g is formed as a spaced portion 44 for disposing the actuator unit 19, and like

the main passage 42a of the second plate 4, it is formed in parallel with a direction of longer length.

[0032]

With the formation of the depressed portion 42g, in the case where the head unit 18 is formed by a lamination of the reservoir unit 40 and the passage unit 18, as shown in FIG. 3, the spaced portion 44 is formed on the part of the depressed portion 42g. The actuator unit 19 is entered into this spaced portion 44 and fixed to a surface facing the reservoir unit 40 of the passage unit 20.

The spaced portion 44 formed by the depressed portion 42g defines an opening on one side of the head unit 18 in a direction of shorter length thereof and the opening is a withdrawn-out opening 45 of a flexible flat cable 4, which will be described later.

[0033]

In addition, the ink supply passage 41a, ink branching passage 42f, ink discharge passage 42b, depressed portion 42g of the reservoir unit 40 are formed on the respective plates 41, 42 by a etching process (including a half-etching) or a laser treatment process.

[0034]

The reservoir unit 40 according to the present embodiment is formed with two plates, that is, the first plate 41 and second plate 42, however, it is not limited to; for example, instead

of one sheet of the second plate 42, by dividing the second plate 42 in a thickness direction into two plates and using the two plates, the reservoir unit 40 may be formed as a three layers form. That is, the reservoir unit 40 is formed by using three plates, namely, the third plate having the ink branching passage 42f and ink discharge passage 42b, the second plate having the depressed portion 42g, dam portion 42e and a through connection hole communicated with the ink discharge passage 42b, and the aforementioned first plate.

[0035]

<Construction of passage unit>

In the following, a detailed construction of the passage unit 20 will be described.

As shown in FIG. 4, a plurality of inlet 20a are formed in zigzag with respect to the direction of longer length of the flat plate 21 on the upper surface of a first layer flat plate of the passage unit 20. The inlet 20a is formed on the location overlapped with the aforementioned ink discharge passage 42b and is communicated with a manifold, which will be described later. In addition, the broken lines shown in FIG.4 denote a location where the actuator unit 19 in a shape of a parallelepiped is adhered and formed.

[0036]

The passage unit 20, as shown in FIG. 5, is formed by laminating nine thin metal sheets 21 to 29. A manifold is formed

spanning through the fifth to seventh later sheet, counted from the top. The manifold passage 30, as described above, communicates with the inlet 20a and further pressure chambers 34, which will be described later, and the ink fed into the passage unit 20 from the inlet 20a is stored therein temporally and serves a common ink chamber to supply the ink to the pressure chambers 34. Additionally, a connection aperture 31 is formed on a fourth layer plate 24 placed on the vertical upper part of the manifold passage 30 and the connection aperture 31 is connected to a narrower portion 32 formed on the third layer plate 23.

[0037]

The narrower portion 32 communicates with one end of the pressure chamber 34 formed on the first layer plate 21 through the connection aperture 33 formed on the second layer plate 22. The pressure chambers 34, which are provided for applying pressure to the ink by a driving of the actuator unit 19, are disposed corresponding to the respective nozzle 13. The other end of the pressure chamber 34 communicates with the nozzle 13 as a through hole in a tapered shape with a tip end, formed on a ninth layer plate 29 (nozzle plate) through the nozzle connection aperture 35 formed through the second to eighth layer plates 22 to 28. As described above, an ink passage through ink passes from the inlet 20a to the nozzle 13.

[0038]

In addition, as shown in FIG. 7, a plan shape of the pressure chamber 34 is almost a diamond form, and the pressure chamber 34 are formed as a matrix shape in which the direction of longer length the plate 21 constituting the pressure chamber 34 is adjacent to the direction of shorter length thereof. The pressure chamber 34 is formed within the location on which the actuator unit 19 is placed as shown in a broken line in FIG. 4. Additionally, the pressure chamber 34 is substantially covered with the actuator unit 19 in FIG. 7, and a part thereof has to be shown in a broken line, but it is described in a solid line for convenience.

[0039]

As shown in FIG. 7, an ink connection passage 20b to be connected to the manifold passage 30 is formed on the inside of the passage unit 20 and an end of the ink connection passage 20b is connected to the inlet 20a. Under this construction, the ink from the inlet 20a is branched properly through the ink connection passage 20b and fed to the manifold passage 30.

[0040]

In addition, the pressure chambers 34, manifold passage 30, narrower portion 32, connection aperture 31, and communication aperture 33, etc., of the passage unit 20 are formed on the respective flat plates 21 to 28 by a etching (including half-etching) or a laser process, and the nozzle 13 on the nozzle plate 29 is formed by a press treatment or

a laser treatment.

[0041]

<Ink flow within the head unit>

In the head unit 18 as configured in an aforementioned manner, the ink supplied from a not shown ink supply source, first, is fed to the inside of the reservoir unit 40 from the ink supply passage 41a and is branched on the branching passage 42f, and then arrives to the ink discharge passage 42b. The ink came out from the ink discharge passage 42b is fed to the manifold passage 30 from the inlet 20a of the passage unit 20. Then, the ink is supplied to the pressure chamber 34 from the connection aperture 31 via the narrower portion 32 and connection aperture 33, and the ink in the pressure chamber 34 is compressed by a driving of the actuator unit 19 so as to be ejected from the nozzle 13 via the nozzle connection aperture 35.

[0042]

<Construction of the actuator unit>

In subsequent, a concrete construction of the actuator unit 19 will be described.

The actuator unit 19, as shown in FIG. 8, is formed including five piezoelectric sheets 70 to 74 of a same thickness. The piezoelectric sheets are continuous flat platelayers and they are disposed spanning through a plurality of pressure chamber 34 formed within the location on which the actuator unit 19 is disposed. The piezoelectric sheets 70 to 74 form

the continuous flat plates and are disposed spanning through a plurality of pressure chambers 34 and thus it maintains a high mechanical strength. In the present embodiment, the piezoelectric sheets 70 to 74 are made of lead zirconate titanate (PZT) ceramic material having ferroelectricity. In addition, through holes 70a, 71a are formed on the piezoelectric sheets 70 to 72. Additionally, the area on which the nozzles 13 are formed denotes ink discharge areas and corresponds to an adhesive area of the actuator unit 19.

[0043]

A common electrode 80a formed on the whole sheet surface is interposed between the piezoelectric sheet 70 on an uppermost layer of the actuator unit 19 and the piezoelectric sheet 71 immediately thereunder. Similarly, a common electrode 80b, as formed in the same manner as the common electrode 80a, is interposed between the piezoelectric sheet 72 immediately under the piezoelectric sheet 71 and the piezoelectric sheet 73 immediately thereunder. In addition, a driving electrode 81a having the almost same planar shape as the pressure chamber 34 is formed on each of the pressure chambers 34 (see FIG. 9). Additionally, a driving electrode 81b, as formed in the same manner as the driving electrode 81a, is interposed between the piezoelectric sheet 71 and piezoelectric sheet 72. Meanwhile, between the piezoelectric sheet 73 immediately under the piezoelectric sheet 72 and the piezoelectric sheet 74

immediately thereunder, and under the piezoelectric sheet 74, any electrodes are not disposed. In the present embodiment, the electrodes 80a, 80b, 81a, 81b are formed of metal material such as Ag-Pd-based metal.

[0044]

Here, the driving electrode 81a, as shown in FIG. 9, has an electrode portion 82 in a substantial diamond form and an electrode portion in a shape of an arrow form formed continuously from an acutely-angled portion of one side of the electrode portion 82. In the electrode portion 82, the projection area with respect to a lamination direction is included in the pressure chamber area (the area surrounded by broken lines in FIG. 9). Meanwhile, in the most part of the electrode portion 83, the projection area with respect to a lamination direction is not included in the pressure chamber area.

[0045]

As shown in FIG. 8, a flexible flat cable 4 (print board) has a base film 4a, a conductive portion 53 formed on the lower surface of the base film 4a and a cover film that is formed to cover the conductive portion 53 with respect to the whole surface of the base film 4a. Meanwhile, the flexible flat cable 4 is disposed such that the cover film 4b is faced with a surface of the piezoelectric sheet 70 on the uppermost layer of the actuator unit 19. In addition, the base film 4a and cover film

4b are both members in a shape of sheet with a dielectric property.

[0046]

In addition, as shown in FIG. 8, in a lower surface of the base film 4a, a bonding pad 55 with conductivity (bonding point) is formed on the lower surface of the base film 4a, corresponding to the one end of the driving electrode 81a. That is, the bonding pad 55 is formed on a location corresponding to the electrode portion 83 of the driving electrode 81a shown in FIG.9. Accordingly, one bonding pad 55 is formed for each of the driving electrodes 81a.

[0047]

Meanwhile, a through hole 52a having a diameter slightly larger than that of the bonding pad 55, as shown in FIG. 8, is formed on the location corresponding to the bonding pad 55 of the cover film 4b. Therefore, in the lower surface of the base film 4b, the most part thereof excluding the bonding pad disposed in a location corresponding to the through hole 52a, is covered with the cover film 52.

[0048]

Additionally, the conductive portion 53 disposed between the base film 4a and cover film 4b is formed of thin cupper and is a wire for connecting the bonding pad 55 to not shown driver IC. Accordingly, the conductive portion 53 is disposed to form a predetermined pattern on the lower surface of the base film 4a.

[0049]

As described above, in the case where the flexible flat cable 4 having the bonding pad on the upper surface of the piezoelectric sheet 70 formed with the driving electrode 81a, the driving electrode 81a is adhered to the bonding pad 55. Therefore, the driving electrode 81a is connected to the driver IC through the bonding pad 55 and conductive portion 53.

[0050]

Since the driving electrodes 81a, 81b are formed corresponding to each of the pressure chambers 34 so as to form an active portion for each of the pressure chamber 34, a driving signal from the driver IC is transmitted between a paired-driving electrodes 81a, 81b to apply voltage thereto and thus the active portion is deformed to protrude towards the pressure chamber 34. As a result, a volume of the pressure chamber 34 is reduced to produce a pressure for ejecting the ink inside the pressure chamber 34.

[0051]

Meanwhile, as shown in FIG. 3, the flexible flat cable 4 is adhered to the actuator unit 19 in the inside of the depressed portion 42g (inside of the spaced portion 44) formed on the second plate 42 of the aforementioned reservoir unit 40. Meanwhile, the flexible flat cable 4 is drawn out from an opening 45 where the spaced portion 44 is formed on one side in a direction of shorter length of the head unit 18. That is, the opening

45 formed on one side in a direction of shorter length of the head unit 18 is a drawn out opening for drawing out the flexible flat cable 4.

The flexible flat cable 4 drawn out from the drawn out opening 45 is extended in zigzag upward and is connected electrically to the drive IC.

[0052]

<Construction of a dam portion>

In the following, a dam portion 42e will be described.

That is, the dam portion 42e is formed on the sheet member placed on the drawn out opening 45 (concretely, on the second plate 42 constituting the reservoir unit 40) so as to protrude toward the passage unit 20.

However, in the dam portion, a tip end of the protruding part is formed spaced apart from the passage unit 20 (formed not cover fully the aforementioned drawn out opening 45) such that a gap for drawing out the flexible flat cable 4 through the drawn our opening 45 is secured.

[0053]

Under this configuration, as shown in FIG. 3, a sealing member 36 is stacked on the location where the flexible flat cable is drawn out from the drawn out opening 45, for sealing the drawn out opening 45 on the side of the head unit 18. The sealing member 36 is silicon based-adhesive and serves for the flexible flat cable 4 not to bend seriously near the drawn out

opening 45. Further, by sealing the drawn out opening 45, the sealing member 36 serves to prevent that ink is entered into the spaced portion 44 through the aforementioned drawn out opening 45 and attached to the actuator electrode, etc., to cause an electric short, etc.

[0054]

However, since the sealing member 36 has low viscosity before a solidification, in the case where the sealing members 36 are stacked to seal the outside of the drawn out opening 45, there may be a problem in that the sealing member 36 enters into the inside of the spaced portion via the drawn out opening 45 and adheres to the actuator unit 19 to obstacle a operation thereof. Particularly, as in the present embodiment mode, in the case where the pressure chambers 34 are disposed in matrix and the driving electrodes 81a, 81b are disposed corresponding to the pressure chamber 34, and the flexible flat cable 4 is disposed corresponding to the locations of the driving electrodes 81a, 81b, the flexible flat cable 4 is typically disposed on the upper side of the head unit 18 such that the flexible flat cable 4 enters into the inside of the head unit 18; thus, the sealing member before a solidification can enter easily into the inside of the head unit 18.

In this regard, in the present embodiment mode, the drawn out opening 45 is narrowed such an extent as the dam portion is formed and thus the sealing member 36 is prevented from

entering into the inside of the spaced portion 44.

[0055]

As a way of forming the dam portion 42e, even though various ways can be considered, in the present embodiment mode, a method of forming simultaneously the depressed portion 42g and dam portion 42e by two steps half-etching is adopted.

More concretely, first, a mask is applied on the location of the second plate 42, where the depressed portion is to formed, and then a first half-etching is preformed. However, the mask is not applied on the location where the dam portion 42e is to be formed (corresponding to the drawn out opening 45). As a result, the depressed portion 42g is formed intermediate in a depth direction thereof and the gap through which the flexible flat cable 4 is drawn out (a gap forming the drawn out opening 45 as a spaced portion apart from the passage unit 20 to the tip of the dam portion 42e in a lamination direction), is formed.

Next, with the mask around the depressed portion 42g remained, a mask is applied to the gap part and an etching again is performed (second etching). As a result, the depressed portion is formed completely and the gap applied a mask is remained as the dam portion 42e.

[0056]

As described above, the ink branching passage 42f and depressed portion 42g are formed by half-etching on the second plate 42 (one sheet of flat plate) placed nearest the passage

unit 20 among flat plates constituting the reservoir unit 40 and thus the numbers of flat plates can be reduced. As a result, a manufacturing cost of the reservoir unit 40 (in addition, the head unit 18) can be reduced and the numbers of processes in fabricating can be reduced.

[0057]

Further, in the present embodiment mode, even though the dam portion 42e is formed on the second plate 42, it is not limited to this configuration. For example, the dam portion may be formed on the flat plate constituting the passage unit 20 nearest the reservoir unit 40 (that is, on the aforementioned first layer plate 21) so as to protrude toward the reservoir unit 40.

[0058]

The present embodiment modes are described, however, the technical scope of the present invention is not limited to the aforementioned embodiment modes, and various variations can be made without departing from the spirit of the present invention.

[0059]

For example, in the aforementioned embodiment modes, the dam portion 42e formed on the second flat plate 42 of the reservoir unit 40 protrudes from the location opposite to the passage unit 20, to the lamination direction; however, it is not limited to this configuration. For example, as shown in FIG. 6,

The dam portion may be formed as other embodiments.

[0060]

The reservoir unit 42′ in the alternative embodiment mode is different from the reservoir unit 40 in the aforementioned embodiment mode in regard to a configuration and second plate 42′ is different.

Since the first plate 41 is the same as the aforementioned, a description thereof is omitted. In addition, with respect to the second plate 42′, the configurations of the ink branching passage 42f and ink discharge passage 42b are the same as formed the second plate 42 in the aforementioned embodiment mode and thus a description thereof is omitted. Additionally, the flat plates, etc., excluding the reservoir unit 40′ are the same as the aforementioned and thus the same reference numerals are given and descriptions thereof are omitted.

[0061]

The second plate 42′ is formed extending to the direction of shorter length thereof as compared with the second plate 42 in the aforementioned embodiment shown in FIG. 4, and has a protrusion part protruding from an edge of an end surface in the direction of shorter length thereof. An edge of the second plate 42′ is remained to form the depressed portion 42g′ by a half-etching, similarly to the second plate 42 in the aforementioned embodiment. The depressed portion 42g′ is a space for disposing the actuator unit 19 and is formed extending

along the direction of longer length thereof.

[0062]

As described above, since the length of the second plate 42' in the direction of shorter length thereof is formed to be slightly longer than the length of the passage unit 20 in the direction of shorter length thereof and thus in the case where the head unit 18 is formed by lamination of the reservoir unit 40' and passage unit, as shown in FIG. 6, the protrusion part of the second plate 42' protrudes vertically from an edge of an end surface in the direction of shorter length the head unit 18. Meanwhile, the dam portion 42e' is formed to protrude from the lower surface of the protrusion part downwardly (in a direction of laminating flat plates).

The dam potion 42e' is formed on the location apart horizontally (vertically to the direction of laminating flat plates) from the passage unit 20 and thus a gap is formed, as shown in FIG. 6, between the tip end of the dam portion 42e' and passage unit 20 (in other words, the gap is formed in such a way as for the depressed portion 42g to be spanned on the protrusion part, and thus it is not covered with the passage unit and exposed outside). An opening is formed on the lower surface of the protrusion part of the second plate 42' and the opening becomes the drawn out opening for drawing out the flexible flat cable 4 (numeral 45).

[0063]

With forming the reservoir unit 40' in an aforementioned manner, the dam portion 42e' in the alternative embodiment is different from the dam portion 42e in the aforementioned embodiment and the whole thickness of the second plate 42' is formed to be remained. As a result, the depressed portion 42g' and dam portion 42e' may be formed by once half-etching to reduce a manufacturing cost.

[0064]

[Effects of the Invention]

As described above, according to claim 1, since a dam portion is formed on the sheet member constituting a head unit, the sealing member can be prevented from entering into the space where an actuator is disposed by a simple structure, without increasing the numbers of components. Accordingly, it can be avoided that the sealing member is adhered to the actuator unit and thus it hinders an operation of the actuator.

[0065]

According to claim 2, in the case where the pressure chambers are arranged in matrix, the driving electrode is installed corresponding to the pressure chamber and the print board is installed corresponding to the locations of a plurality of electrodes, the print board is typically disposed on the upper part of the head unit and the print board enters into the inside of the head unit, and thus the sealing member can enter easily into the inside of the head unit. Even in this

case, according to the present configuration, the sealing member can be prevented from entering into and adhering to the actuator unit by the dam portion, thereby avoiding operational obstacle of the actuator unit.

[0066]

According to claim 3, the dam portion is formed by once etching; therefore, a manufacturing cost can be reduced.

[0067]

According to claim 4, half-etching one sheet member forms the dam portion. Therefore, a manufacturing cost can be reduced. In addition, the numbers of process can be reduced.

[Brief Description of the Drawings]

[FIG. 1]

FIG. 1 is a side view of an entire construction of an ink-jet head (printer) according to an embodiment of the present invention.

[FIG. 2]

FIG. 2 is a bottom view showing a state in which ink-jet heads are arranged adjacent each other.

[FIG. 3]

FIG. 3 is a partly cross-sectional view of the side of the ink-jet head.

[FIG. 4]

FIG. 4 is a schematically perspective view of a branched passage-unit of the ink-jet head body.

[FIG. 5]

FIG. 5 is a sectional enlarged view showing an ink passage within the passage unit.

[FIG. 6]

FIG. 6 is a partly cross-sectional view showing a side of a variant embodiment of a reservoir unit of the ink-jet head.

[FIG. 7]

FIG. 7 is an enlarged plan view of main parts showing a state in which an actuator unit is installed to the passage unit.

[FIG. 8]

FIG. 8 is an enlarged cross-sectional view of the areas viewed form a side direction, and surrounded by the part shown with broken-lines in FIG. 5.

[FIG. 9]

FIG. 9 is a schematically view showing a shape of a driving electrode.

[Description of Reference Numerals and Signs]

1: ink-jet printer (ink-jet recording device)

2: ink-jet head

4: flexible flat cable (print board)

13: nozzle

18: head unit

19: actuator unit

20: passage unit

20a: inlet

21-29: flat plate (sheet member)

30: manifold passage

34: pressure chamber

40: reservoir unit

41: first plate (flat plate, sheet member)

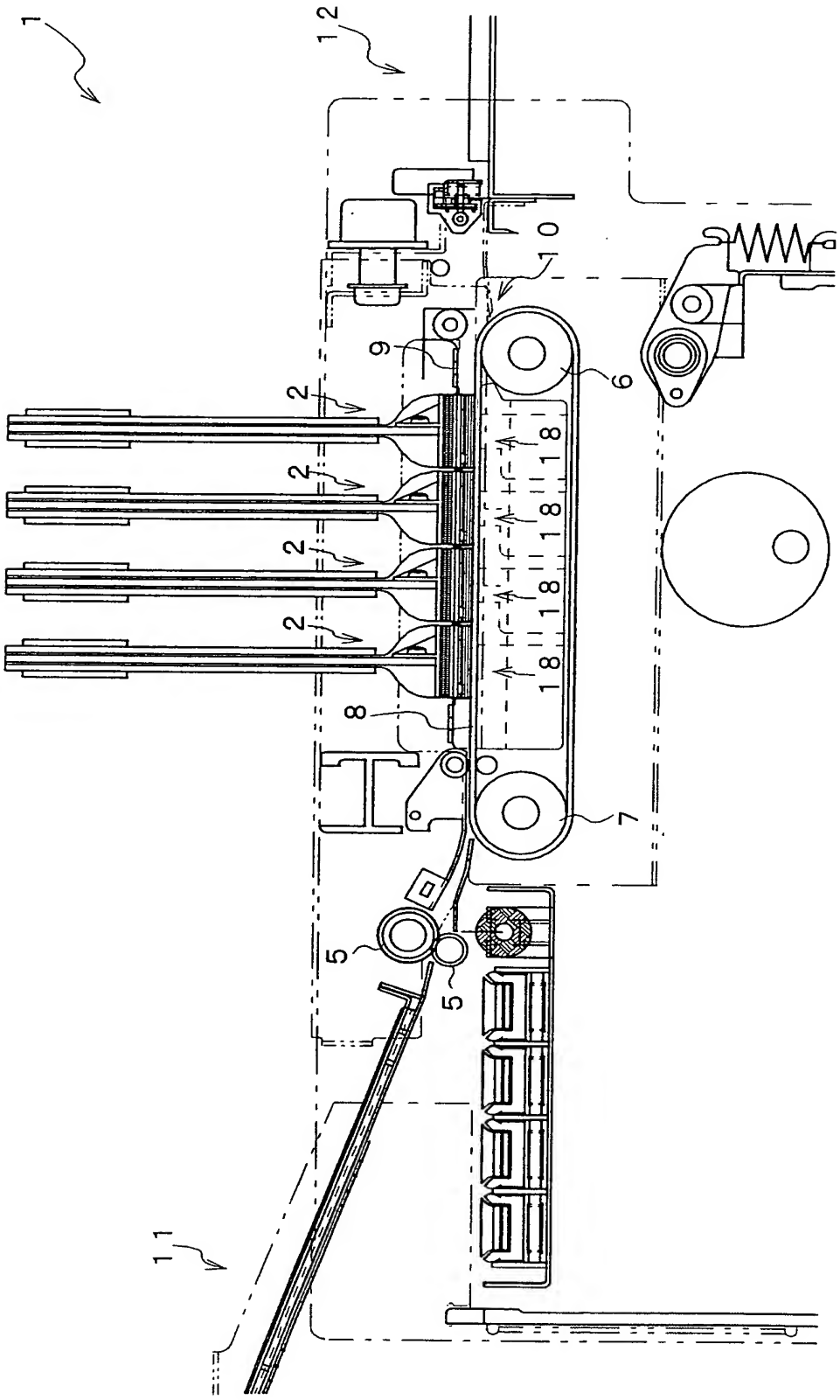
42: second plate (flat plate, sheet member)

42e: dam portion

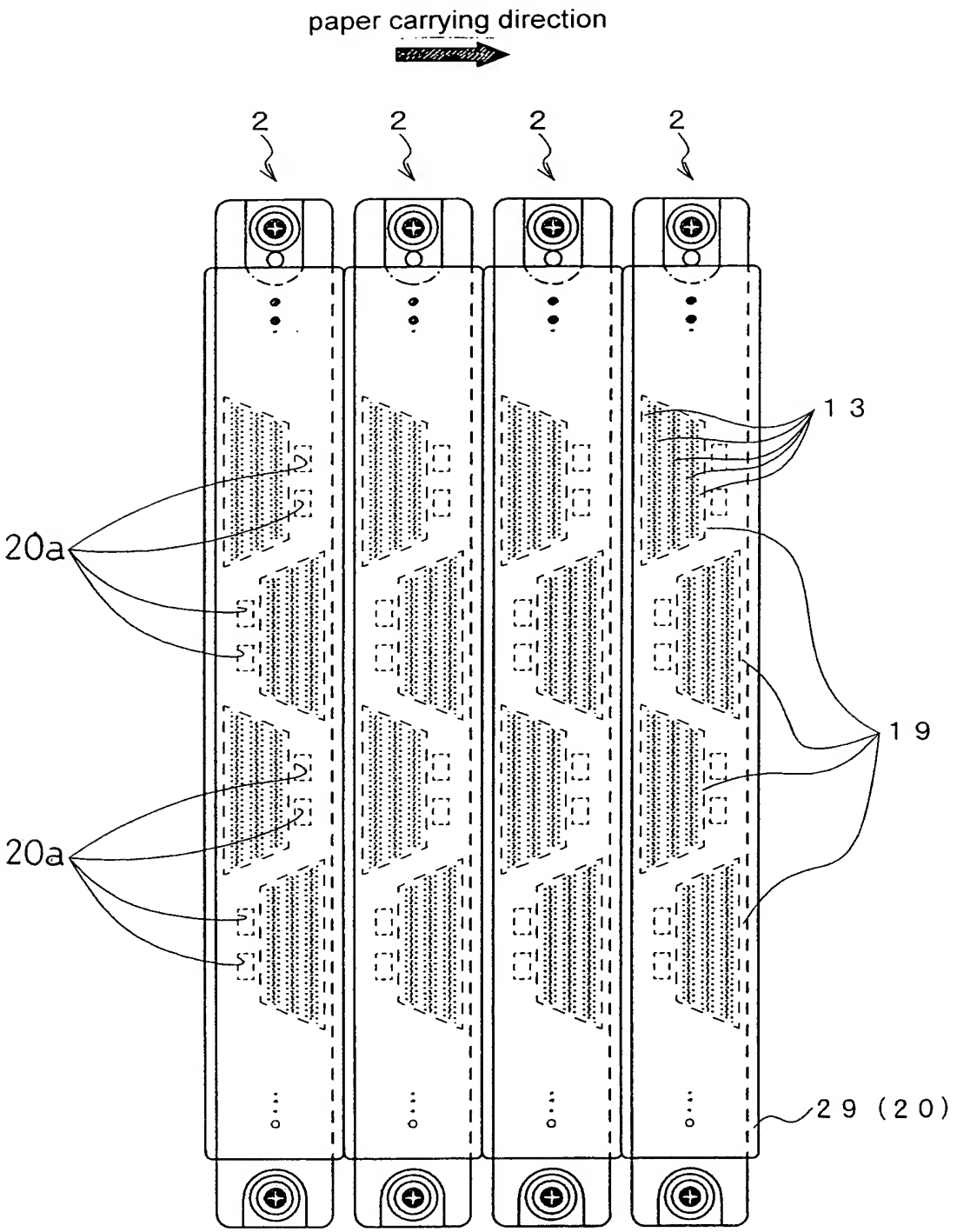
45: drawn out opening (for the print board)

[Document Name]Drawings

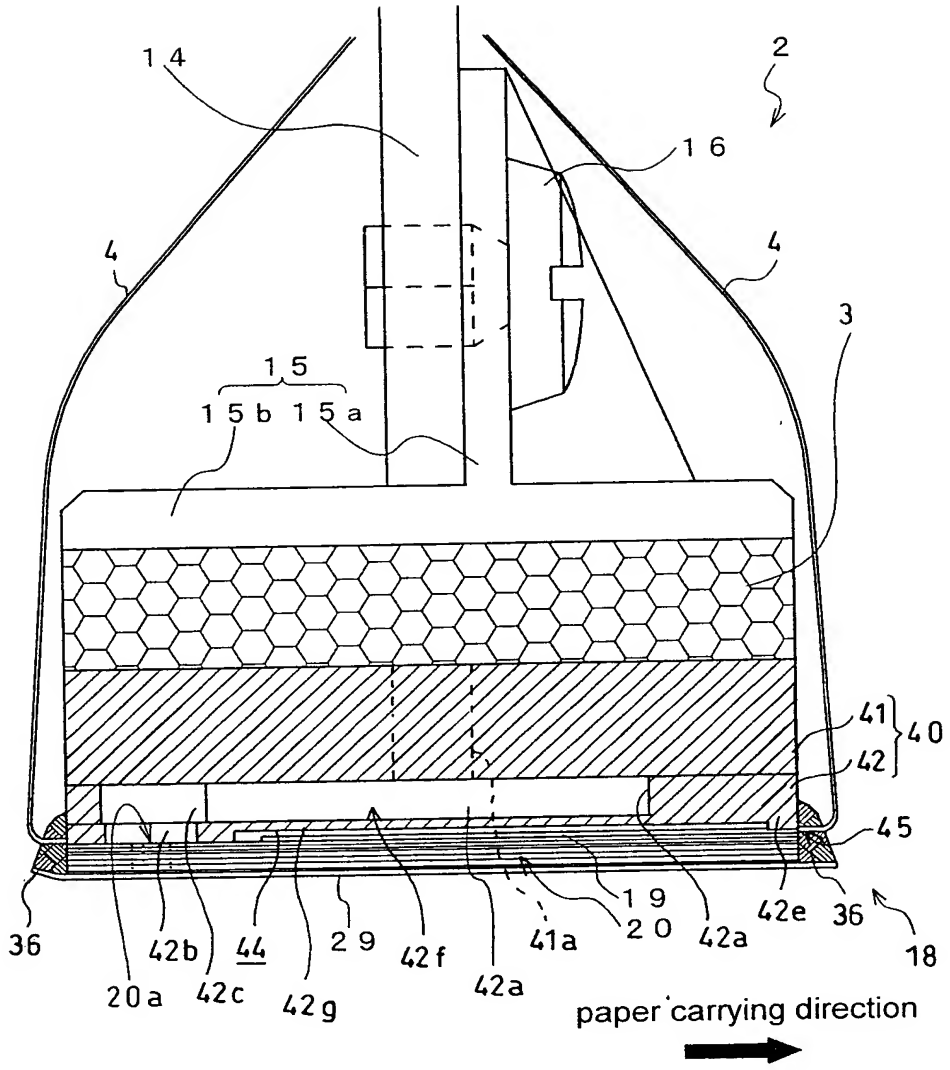
[FIG. 1]

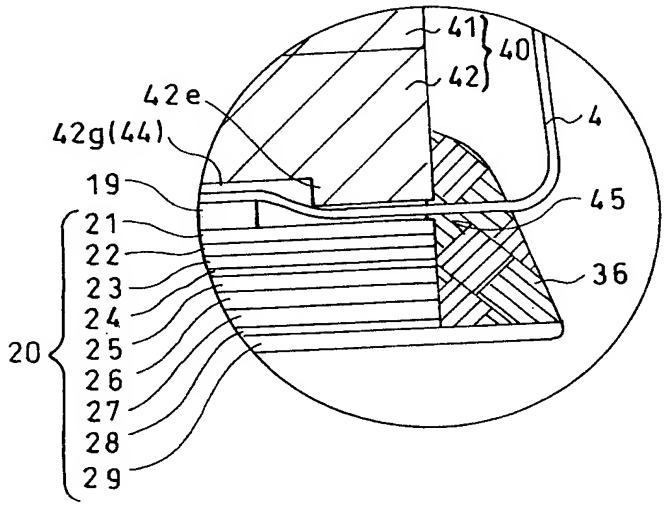


[FIG. 2]

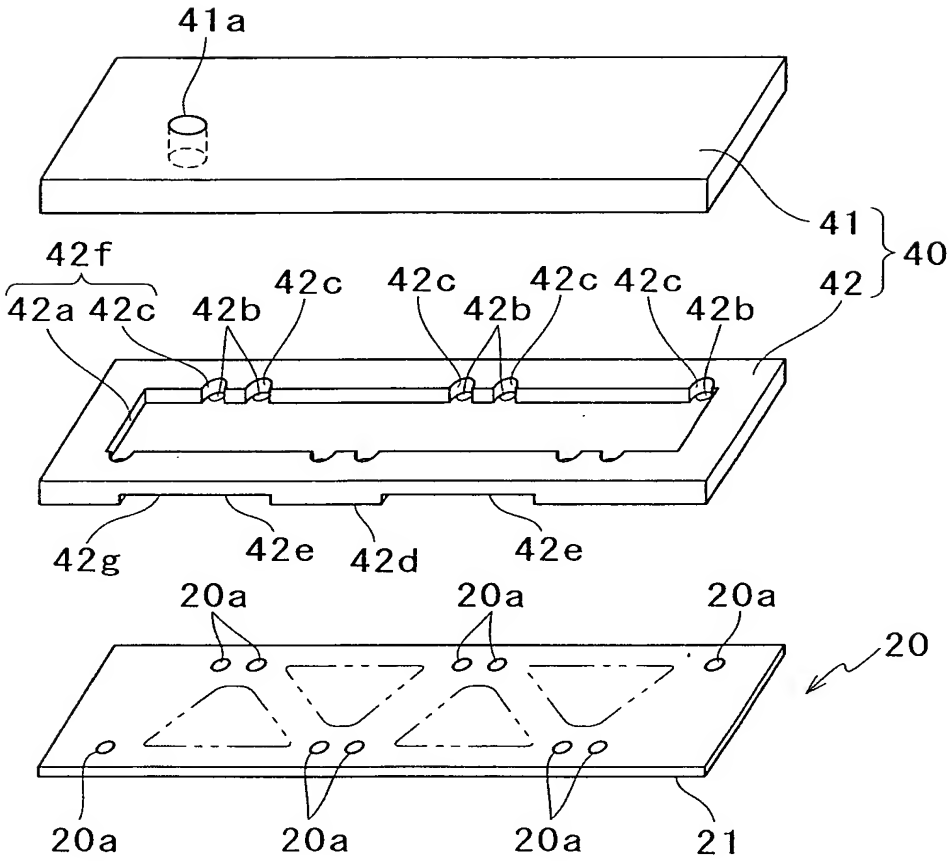


[FIG. 3]

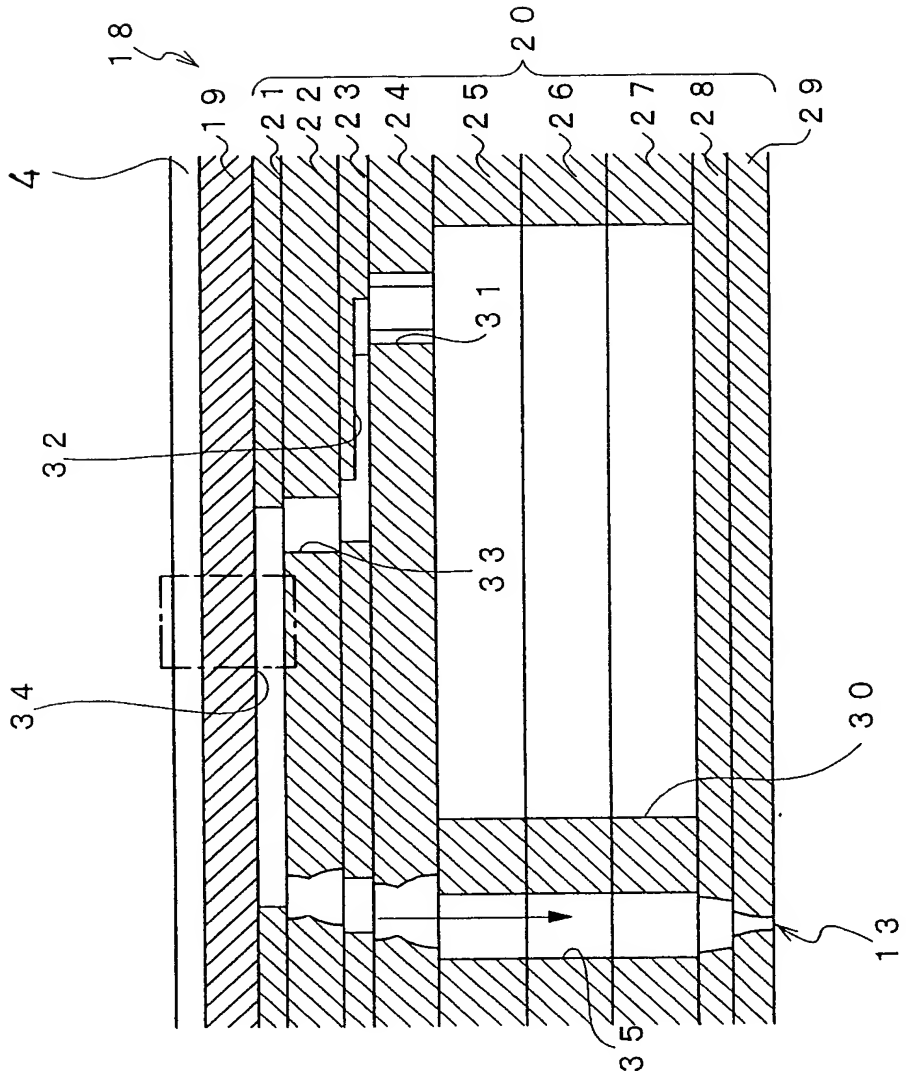

14
2
16
4
4
3
15
15b 15a
41
40
42
45
36
42b
44
29
42f
41a
19
20
42a
42e
36
18
20a
42c
42g
42a
paper carrying direction


41
40
42
42e
4
42g(44)
19
45
21
22
23
24
20
25
26
27
28
29
36

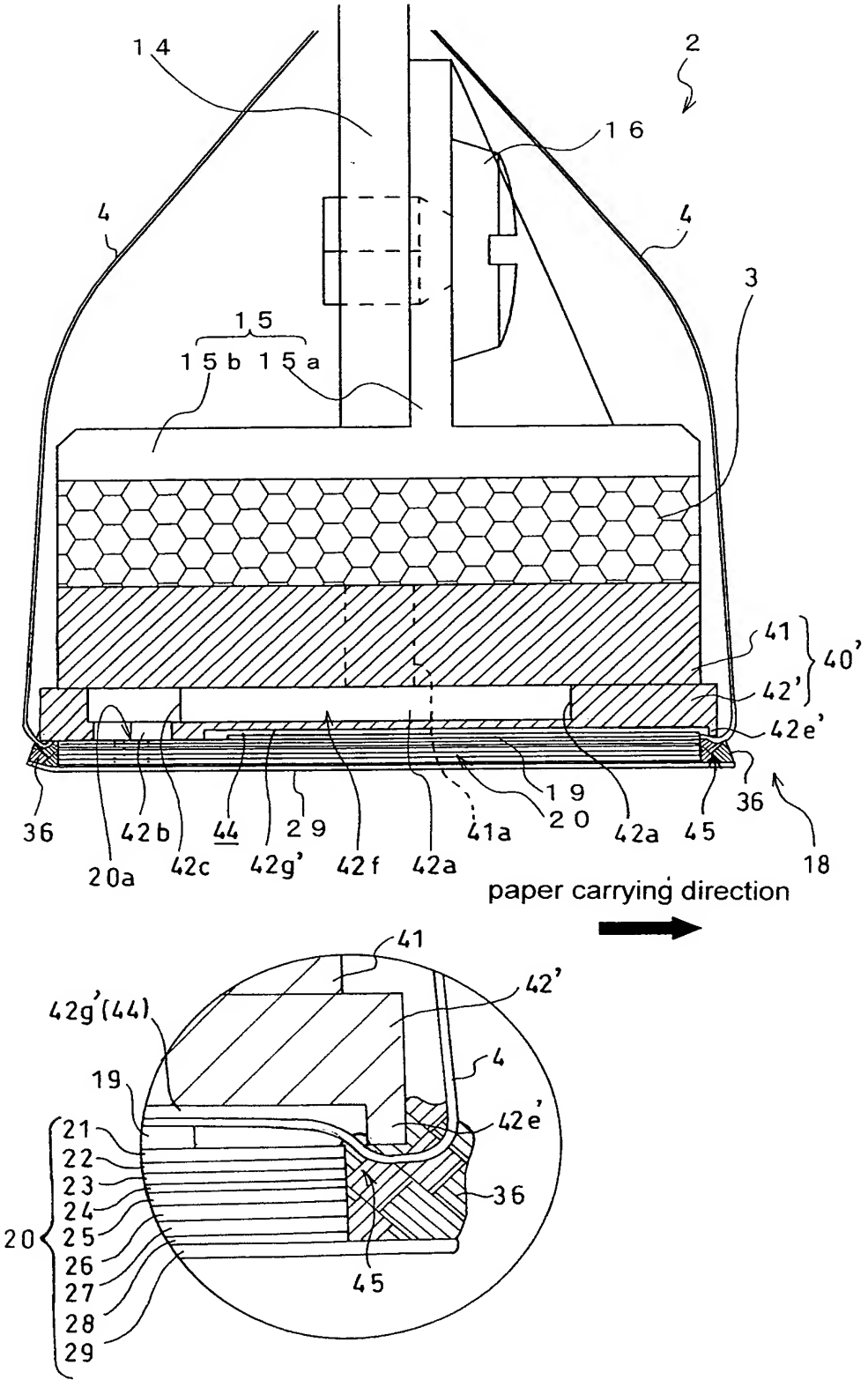
[FIG. 4]


41a
41
40
42
42f
42a
42c
42b
42c
42c
42c
42c
42b
42b
42g
42e
42d
42e
20a
20a
20a
20
20a
20a
20a
21

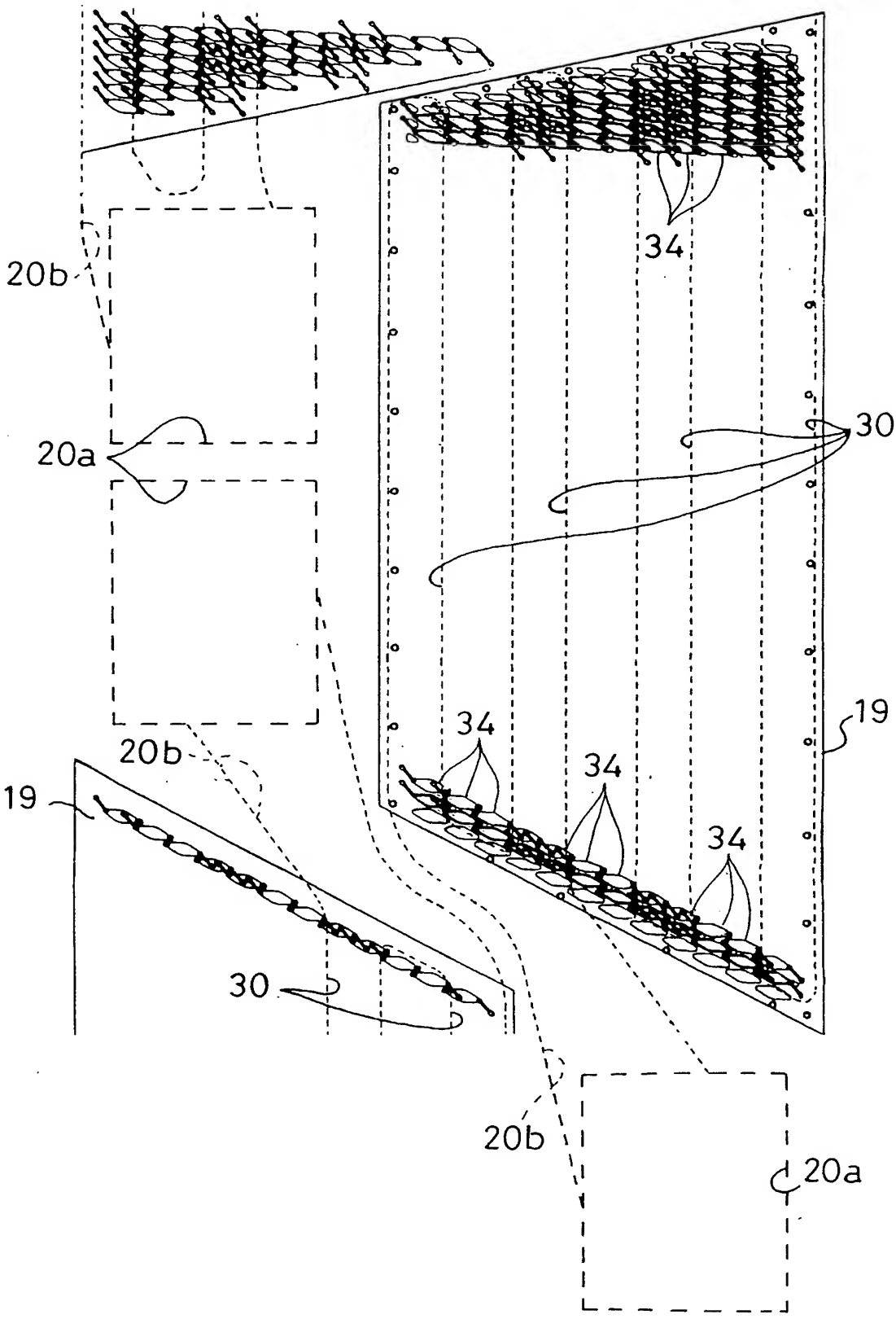
[FIG. 5]



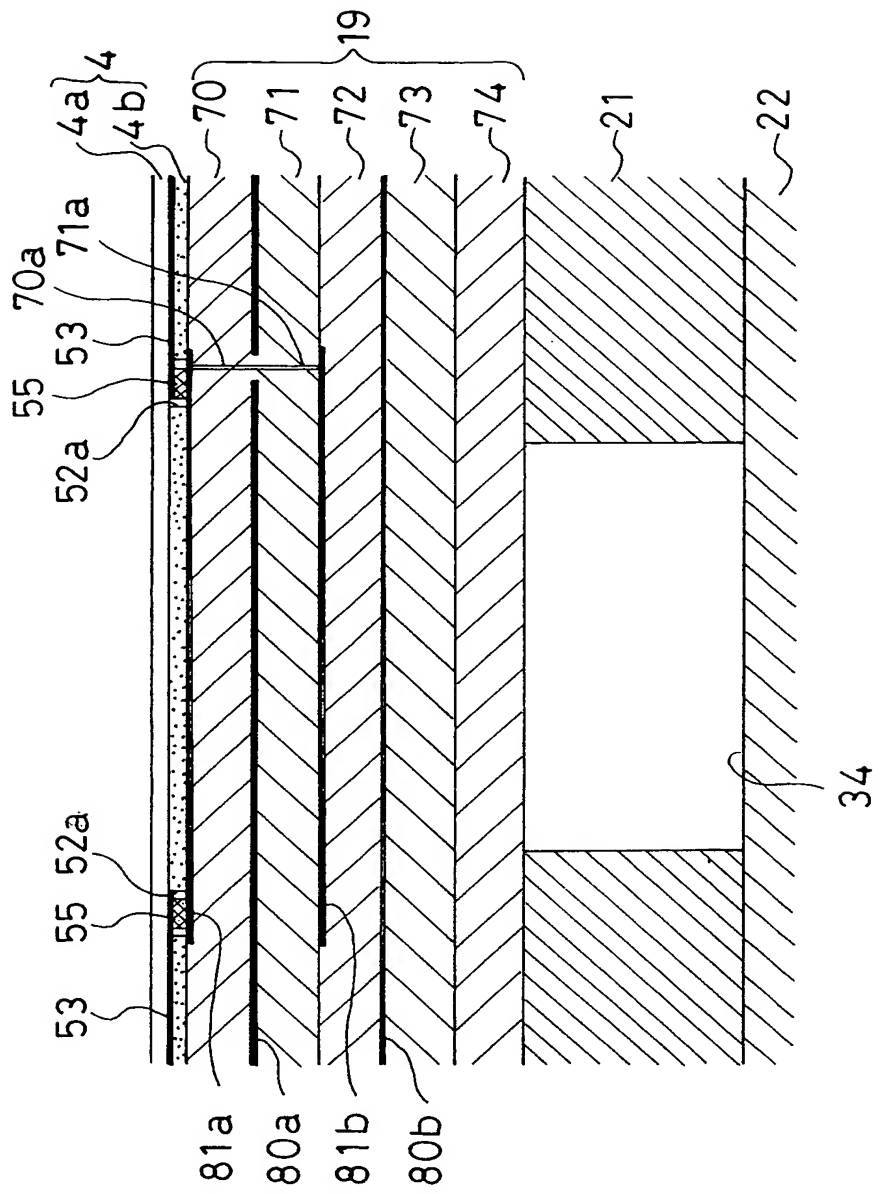
[FIG. 6]


14
2
16
4
4
3
15
15b 15a
41
40'
42'
42e'
36
19
20
36
42b
44
29
41a
42a
45
18
20a
42c
42g'
42f
42a
paper carrying direction
41
42'
42g'(44)
4
19
42e'
21
22
23
24
20
25
26
27
28
29
36
45

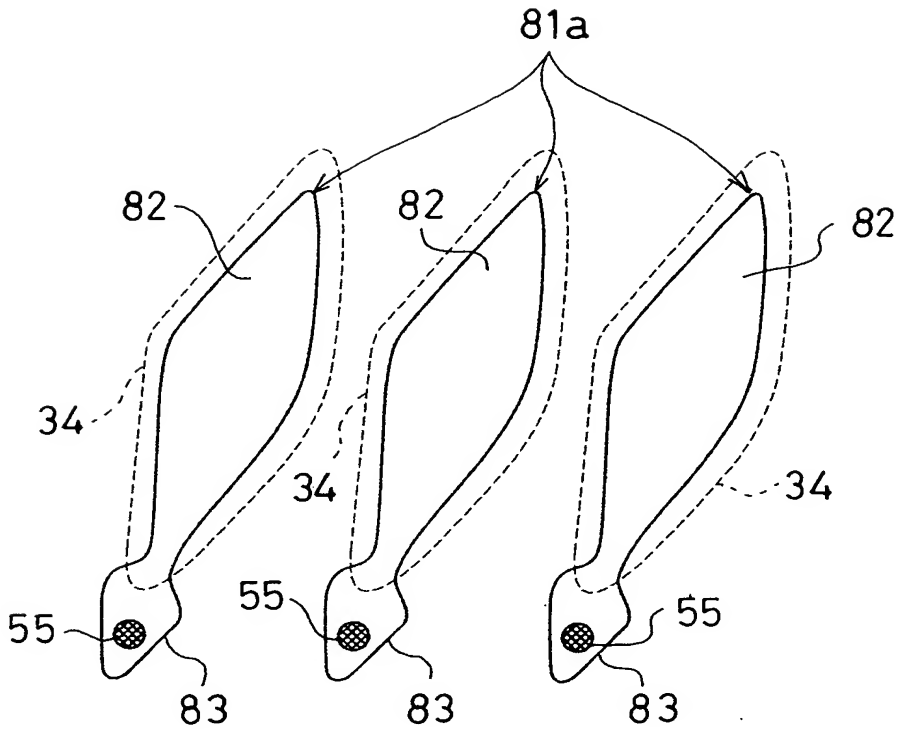
[FIG. 7]



[FIG. 8]


4
4a
4b
19
70
71
72
73
74
21
22
71a
70a
53
55
52a
52a
55
53
34
81a
80a
81b
80b

[FIG. 9]



[Document Name]Abstract

[Abstract]

[Problem]

A sealing member is prevented from entering into a space where an actuator unit is disposed.

[Means for Resolution]

An ink-jet head 2 comprising: a head unit 18 including a plurality of ink ejecting nozzles, a plurality of pressure chambers communicating with the respective nozzles, a common ink chamber communicating with the pressure chambers, and an actuator unit 19 for imparting squirting energy to the ink in the pressure chambers, the head unit 18 being formed by laminating a plurality of sheet members; and a print board 4 connected to the actuator unit 19, wherein a dam portion 42e is formed on one sheet member 42 of the sheet members which is placed on an opening 45 for drawing out the print board, the dam portion protruding to a direction of laminating the sheet members.

[Selected Figure]

FIG. 3